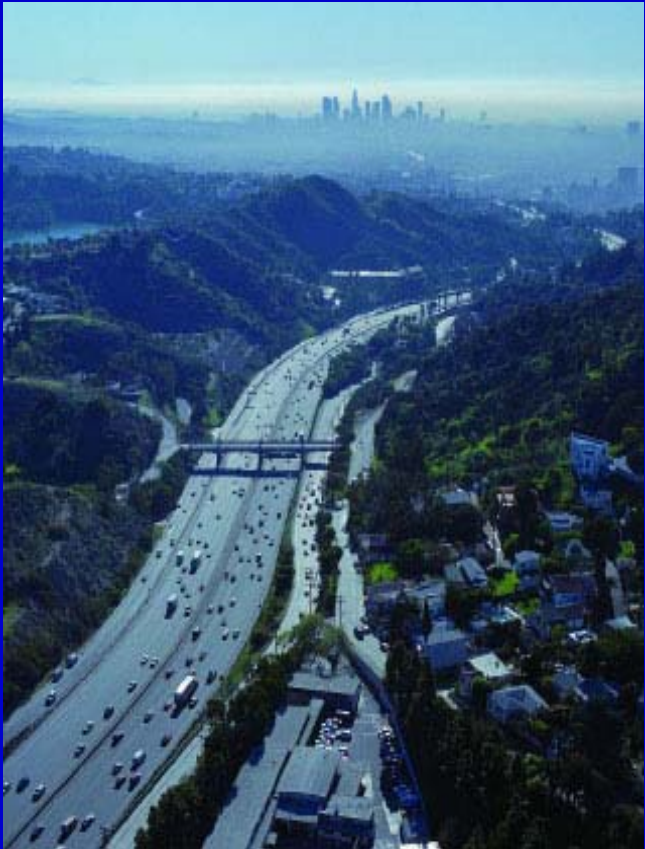


Linking Survey and Ambient Monitoring Data to Identify Geographic Patterns of Asthma Exacerbations and Air Pollutants



Funded by

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Ying-Ying Meng, Beate Ritz, John Froines, Rick Brown,
Michelle Wilhelm, Rudy Rull, Marlena Kane



www.healthpolicy.ucla.edu

Study Goals

- ❖ Develop a model surveillance system that links asthma data from the California Health Interview Survey (CHIS) with air pollution data from ambient monitors;
- ❖ Identify geographic patterns of air pollution and asthma exacerbation.

The California Health Interview Survey

- * CHIS is a biannual survey with a representative sample of the California population. CHIS uses a two-stage, geographically stratified random-digit-dial (RDD) sample design for its primary survey.
- * In 2001, 73,821 respondents completed the survey, and interviews were conducted in English, Spanish, and four Asian languages (Chinese, Japanese, Korean, and Khmer). Data were collected between November 2000 and September 2001.
- * Based on CHIS 2001, 3.9 million people in California have been diagnosed with asthma at some point in their lives.

Study Outcomes

* CHIS Respondents were asked to report:

- ❖ The frequency of asthma symptoms such as coughing, wheezing, shortness of breath, chest tightness, or phlegm over the previous 12 months.
- ❖ Whether they had ever visited a hospital emergency room (ER) or been hospitalized due to asthma during this period.

* Study outcomes:

- ❖ Daily or weekly (persistent) vs. less than weekly (intermittent) symptoms.
- ❖ Asthma-related ER visit or hospitalization vs. none.
- ❖ Uncontrolled asthma: persistent asthma and/or asthma-related ER visit or hospitalization.

Study Areas

* Greater Bay Area

- ❖ San Francisco, Alameda, Santa Clara, Contra Costa, San Mateo, Sonoma, Solano, Marin, Napa

* San Joaquin Valley

- ❖ Fresno, Kern, San Joaquin, Stanislaus, Tulare, Merced, Kings, Madera

* Los Angeles County

Study Population

- * Respondents to CHIS 2001 who reported having a previous asthma diagnosis and residing in one of three study regions:

Region	N	Daily or Weekly Symptoms	Asthma-Related ER Visit or Hospitalization
San Francisco Bay Area	1961	20.5%	6.8%
San Joaquin Valley	1502	25.7%	9.2%
Los Angeles County	1812	19.2%	8.9%

* Prevalence estimates are unweighted and exclude missing data

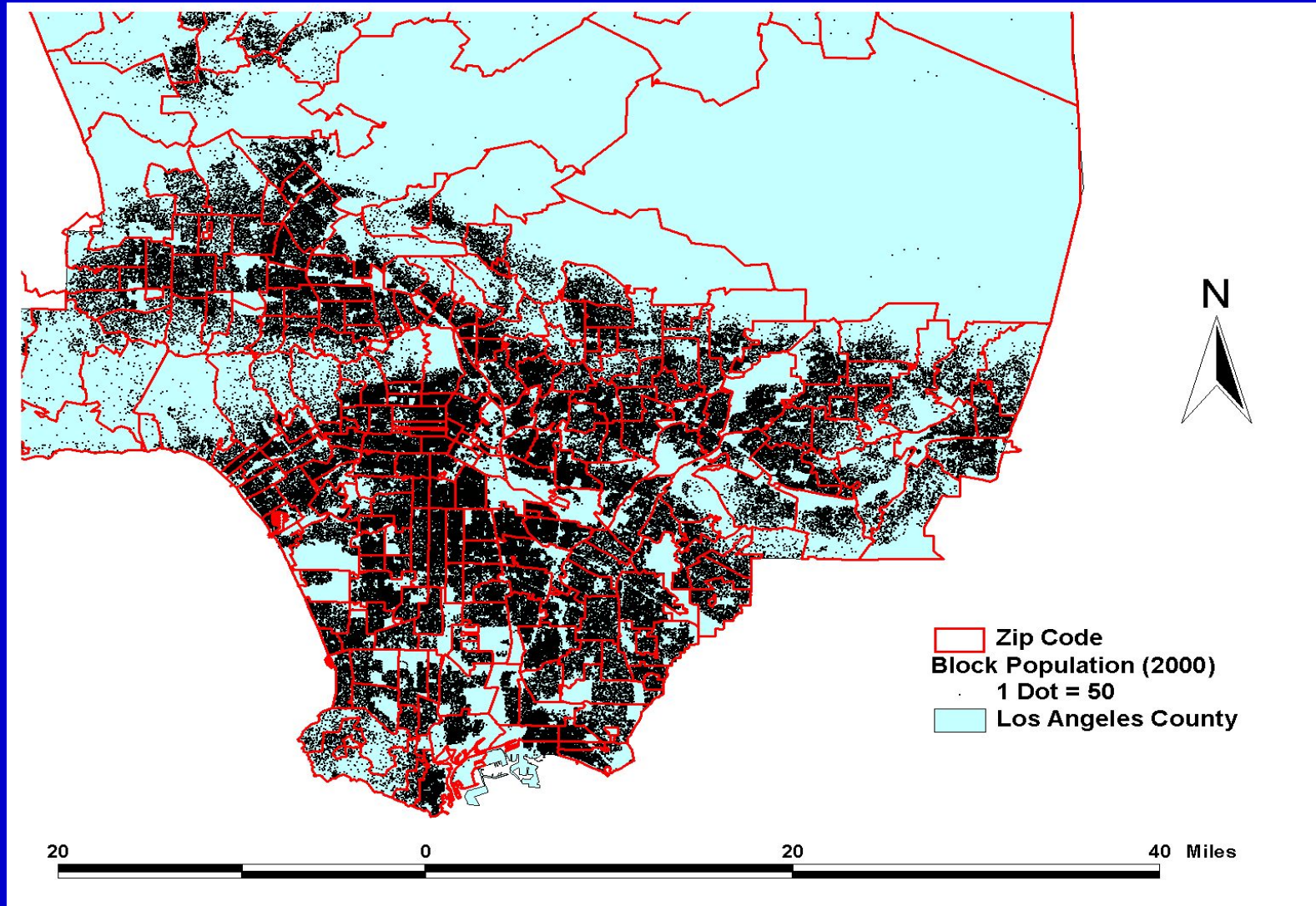
Air Monitoring Data

- * California has 250 monitoring stations that measure ambient levels of gaseous and particulate air pollutants. There are 88 stations in the study areas.
- * For this project, hourly measurements for O_3 and 24-hour measurements for Particulate Matter (PM_{10} , $PM_{2.5}$) were averaged over the one-year period prior to the interview date for each respondent with asthma.
- * Eliminate those stations that may potentially distort the annual averages (e.g. some stations only measure ozone levels during the peak summer season).

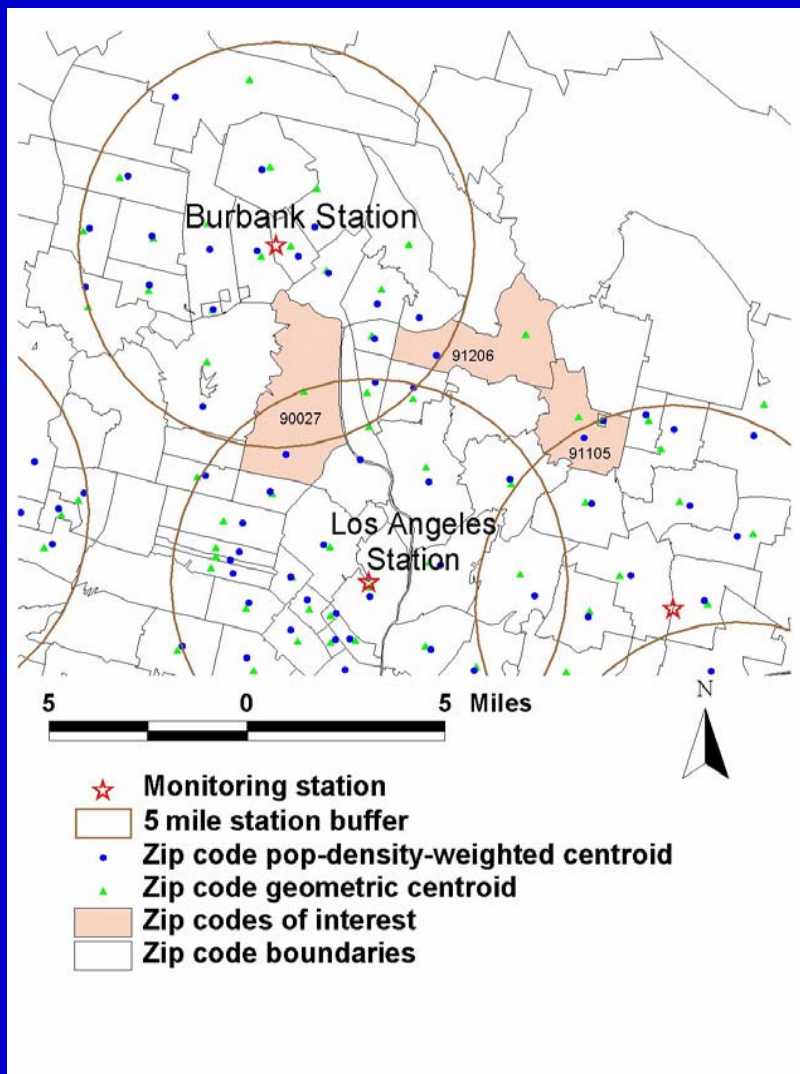
Linkage of Health and Pollutant Data

- * Residential zip codes were obtained from all CHIS 2001 respondents; nearest residential cross-streets were also obtained from Los Angeles and San Diego County respondents;
- * Zip codes vary greatly in size, shape, and population distribution.

Population Distribution in LA Zip Codes



Data Linkage Methods Tested in LA



Cross Street Distance (Gold Standard)

Streets to closest air monitoring station within a 5-mile radius.

Zip Code Combined Method

A combination of distance (not restricted to 5 miles), topographical, and meteorological factors.

Zip Code Population Centroid Method

Identify center of zip code weighted by population densities of US Census Blocks (2000).

Zip Code Geometric Centroid Method

Assign if a geometric centroid of zip code is within a 5-mile radius of an air monitoring station (see map).

60% Zip Code Area Method

Assign if at least 60% of the zip code area fell within a 5-mile radius of the monitoring station.

Findings: Ozone (per 1pphm) and Uncontrolled Asthma

Method	Odds Ratio (OR) (95% Confidence Interval (CI))	N uncontrolled asthma, N controlled asthma
Cross Street Distance within 5-miles (gold standard)	1.29 (1.04, 1.61)	344, 1007
Zip Code Combined (distance, topography, meteorology)	1.30 (1.05, 1.61)	433, 1303
Zip Code Population Centroid within 5-miles	1.31 (1.05, 1.64)	324, 972
Zip Code Geometric Centroid within 5-miles	1.25 (0.95, 1.64)	300, 921
60% Zip Code Area within 5-miles	1.17 (0.87, 1.56)	260, 799

* Adjusted for age, poverty level, gender, ethnicity, and health insurance coverage.
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Regional Variations of Annual Pollutant Concentrations

Region	Median (Interquartile Range)		
	Ozone (pphm)	PM ₁₀ (ug/m ³)	PM _{2.5} (ug/m ³)
San Francisco Bay Area	1.79	22.06	15.23
	1.59 - 2.03	20.43 - 24.55	13.94 - 16.89
San Joaquin Valley	3.03	42.67	21.40
	2.71 - 3.40	31.72 - 44.34	17.90 - 23.50
Los Angeles County	1.98	40.75	21.33
	1.69 - 2.16	37.37 - 42.33	19.74 - 22.68

* Medians and interquartile (25 – 75%) ranges based on respondents in zip codes with population centroids ≤ 5 mi from monitoring station.

Study Population

	Daily or Weekly Symptoms		ER Visit or Hospitalization	
Total	1119 (21.5%) of 5202		433 (8.2%) of 5275	
	n	Percent	n	Percent
Age 0-17	170	11.8%	158	10.8%
Age 18-34	201	19.6%	67	6.4%
Age 35-64	530	24.8%	166	7.7%
Age 65+	218	36.5%	42	6.9%
Sex	Yes		Yes	
Male	392	18.3%	162	7.5%
Female	727	23.7%	271	8.7%
Latino	157	18.1%	106	12.0%
Asian/Other	124	17.9%	70	10.0%
African American	94	18.2%	70	13.4%
White	744	23.8%	187	5.9%
<100% FPL	211	30.7%	90	12.9%
100-299% FPL	389	22.3%	180	10.2%
300%+ FPL	519	18.7%	163	5.8%
Currently Uninsured	95	21.9%	28	6.3%
Uninsured Any Past 12 Months	54	22.7%	21	8.8%
Insured All Past 12 Months	970	21.4%	384	8.4%

Ozone Effects: Combined Region Results

Quartile Range (pphm)	Daily or Weekly Symptoms	ER Visit or Hospitalization
	654 cases, 2470 noncases	278 cases, 2894 noncases
<1.71	1.00	1.00
1.71-1.98	0.92 (0.70, 1.20)	1.37 (0.96, 1.94)
1.99-2.41	0.84 (0.64, 1.11)	1.33 (0.94, 1.89)
2.42+	1.36 (1.05, 1.77)	1.59 (1.13, 2.24)
Continuous (per 1 pphm)	1.24 (1.09, 1.42)	1.19 (1.01, 1.41)

* Based on respondents in zip code population centroids ≤ 5 mi from monitoring station.

* Odds ratios adjusted for age, sex, race/ethnicity, and poverty level.

Effects on Daily/Weekly Symptoms

Daily or Weekly Symptoms	San Francisco Bay Area	San Joaquin Valley	Los Angeles County
Ozone per pphm	1.22 (0.74, 2.00)	1.23 (0.94, 1.60)	1.16 (0.91, 1.49)
PM ₁₀ per 10 ug/m ³	0.66 (0.39, 1.15)	1.29 (1.05, 1.57)	1.03 (0.71, 1.50)
PM _{2.5} per 10 ug/m ³	1.32 (0.34, 5.06)	1.82 (1.11, 2.99)	0.84 (0.50, 1.43)

* Based on respondents in zip code population centroids ≤ 5 mi from monitoring station.

* Odds ratios adjusted for age, sex, race/ethnicity, and poverty level.

Effects on ER Visits or Hospitalization

	San Francisco Bay Area	San Joaquin Valley	Los Angeles County
Ozone per pphm	2.88 (1.51, 5.51)	1.49 (1.05, 2.11)	1.04 (0.76, 1.42)
PM ₁₀ per 10 ug/m ³	0.58 (0.28, 1.22)	1.29 (0.99, 1.69)	1.12 (0.69, 1.81)
PM _{2.5} per 10 ug/m ³	0.04 (0.004, 0.29)	1.47 (0.76, 2.84)	1.03 (0.53, 2.02)

* Based on respondents in zip code population centroids ≤ 5 mi from monitoring station.

* Odds ratios adjusted for age, sex, race/ethnicity, and poverty level.

Implications

- * Asthma is a multifactorial condition. CHIS makes possible to examine the relationship between air pollution and asthma when controlling for many potential confounding factors, such as socioeconomic status and access to care;
- * Given the nature of the condition, local-level or community-based asthma interventions are very important. The results will help develop environmental strategies that will improve the control of asthma.

Future Directions

- * Subsequent CHIS (2003, 2005, etc.) will have residential addresses for the respondents. This will provide opportunities to:**
 - ❖ Improve quality of exposure assessment with use of exact addresses;
 - ❖ Assess air pollutant impacts on a larger population in different areas;
 - ❖ Monitor trends in environmental hazards and diseases;
 - ❖ Develop or measure intervention strategies at the State or local levels.

Thanks !

Ying-Ying Meng, DrPH
UCLA Center for Health Policy Research
10911 Weyburn Avenue, Suite 300
Los Angeles, California 90024
(310) 794-2931
yymeng@ucla.edu



www.healthpolicy.ucla.edu